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Magnetic Resonance Imaging

Week 4; Lexture 9; Section 2: Determination of T_2

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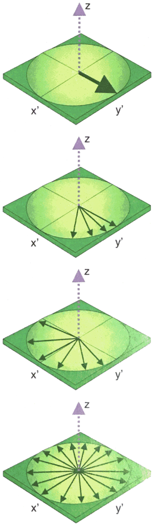
Section 1

Determination of the spin-spin relaxation time, T_2

Spin-spin relaxation time, T_2



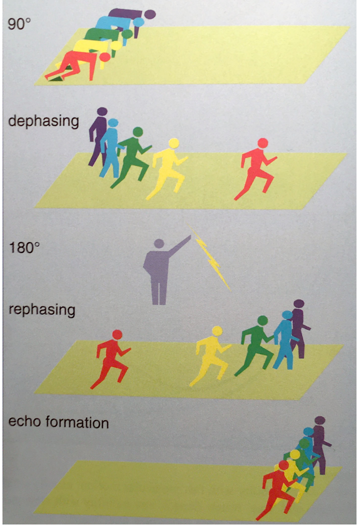
System set up in equilibrium; net magnetisation, $\mathbf{M}_{\rm eqm}$, parallel to $\mathbf{B}_0$ and of magnitude $M_{\rm eqm}$

90° RF magnetic field pulse applied to rotate net magnetisation, $\mathbf{M}_{\rm eqm}$, into x, y plane

Take $t = 0$ to be time at which 90° degree pulse ends. At this instant net magnetisation begins to precess around $\mathbf{B}_0$

Rate of precession of individual ^{1}H nuclei depends on local magnetic environment: some precess faster, some slower. Results in decoherence, time constant T_2^* (see lecture 8)

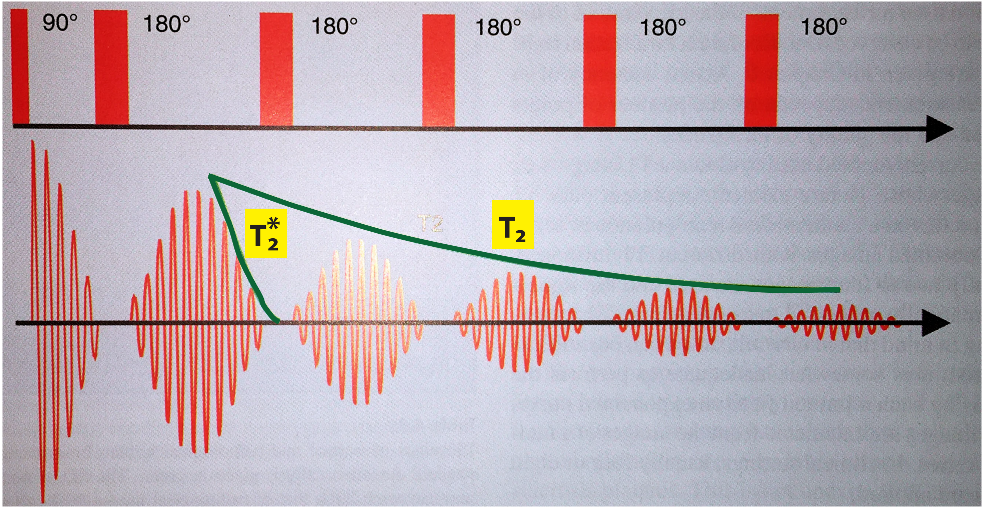
Spin-spin relaxation time, T_2



Before "doing the spins", an analogy:

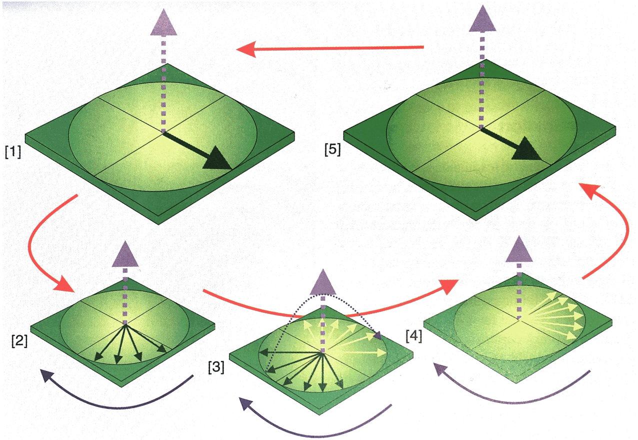
- A set of sprinters have been prepared at the starting line
- The "starting gun" is the end of the 90° pulse
- The sprinters run for a period of time, $t_{\rm run}$
- At $t_{\rm run}$ the sprinters' phase is rotated by 180°:
  The first becomes the last, etc.
- After a further $t_{\rm run}$ all sprinters are back in line
- The line of sprinters at $t = 2t_{\rm run}$ is an "echo" of the situation at $t = 0$

Spin-spin relaxation time, T_2



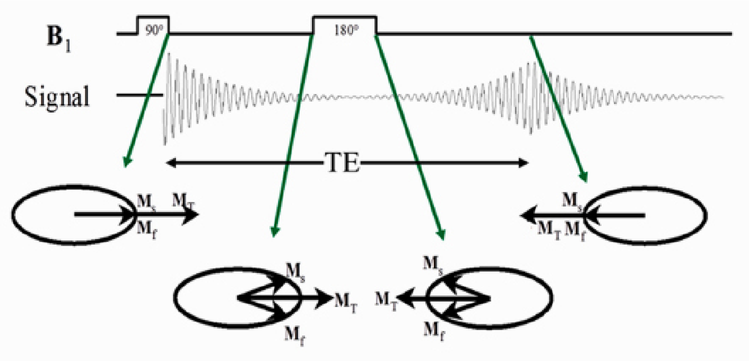
The spin-spin relaxation time constant, T_2

"**Spin echo sequence**", graphical representation of evolution of magnetisation

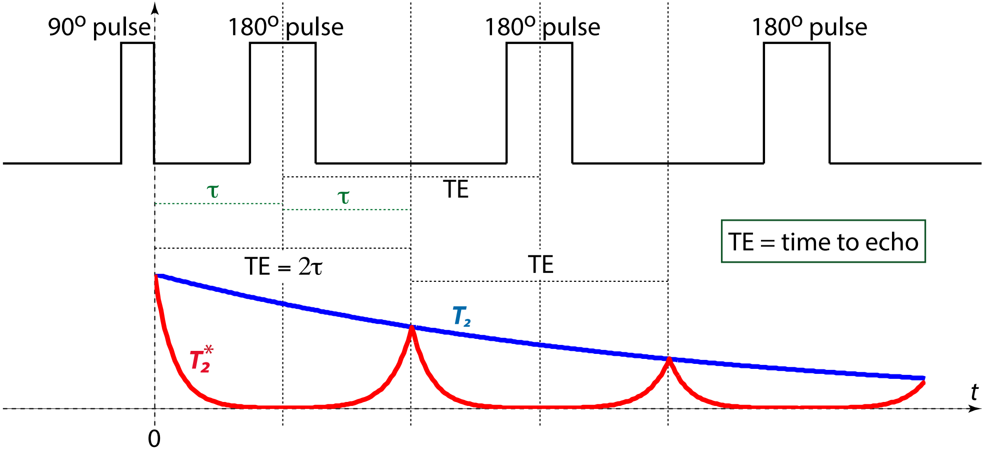


The spin-spin relaxation time constant, T_2

"**Spin echo sequence**", graphical representation of evolution of magnetisation



Spin-spin relaxation time, T_2



$$M_{xy}(\mathrm{TE}) = M_{\mathrm{eqm}} \exp\left(-\frac{\mathrm{TE}}{T_2}\right)$$

Summary of section 2

T_2, the spin-spin, relaxation time constant can be reconstructed using a spin-echo pulse sequence